Range expansion of the introduced cane toad *Bufo marinus* in New South Wales

Wendy Seabrook

University of Sydney, School of Biological Sciences, New South Wales, Australia 2006

ABSTRACT

Cane toads were introduced directly into New South Wales at Byron Bay between 1964 and 1966. This survey of their distribution found that cane toads now have a continuous distribution from the Queensland–New South Wales border south to Broadwater, west to Lismore, and along the river valleys west of Mullumbimby and Murwillumbah. The maximum rate of spread has occurred in a southerly direction at approximately 1.3 km/year, but was slower than the average rate recorded between 1965 and 1978. Although human-assisted spread was reported, natural range expansion could not be excluded, except in cases where cane toads had been introduced into areas outside their current range. Many incidents of cane toad releases into new areas were reported, extending as far south as Sydney. To date none have established viable populations except at Yamba. This population should be eradicated, and a public awareness campaign needs to be implemented to help reduce the number of toads being transported beyond their current range.

INTRODUCTION

Cane toads *Bufo marinus* were introduced from Hawaii into Australia in Queensland in 1935, and from there into northeastern New south Wales at Byron Bay, between 1964 and 1966 (van Beurden and Grigg 1980). They were brought into Australia to control the grey-backed beetle *Dermolepida albohirtum* which "periodically caused wholesale havoc in the sugar cane fields" (Mungomery 1936). Their success in controlling the beetle was never evaluated, and by 1950 an insecticide was developed.

Between the early 1960s and 1978 the New South Wales population expanded its range at a mean rate of 3 km/year, but remained separated by approximately 20 km from the southern limit of the Queensland population (van Beurden and Grigg 1980). Cane toads are thought to be capable of colonizing the northern sections of the western slopes of the Great Dividing Range in New South Wales (van Beurden 1981; Floyd 1983) and the coast, either as far south as Wollongong (Floyd 1983), or further south along the coast into South Australia and even northern Tasmania (van Beurden 1981).

In view of the widespread concern about the potential impact of cane toads on native fauna (Covacevich and Archer 1975; Freeland 1985; Tyler 1989; van Beurden 1980), it is essential to monitor the spread of this introduced species as a first step in evaluating whether control programmes are required, and to provide information on how control may best be achieved. In this paper, I present the results of a survey of the distribution of cane toads in New South Wales carried out in 1989–1990. This is the first survey of the distribution of cane toads in the State since 1978, and forms part of a wider study into the habitat use and impact of the cane toad on native fauna in New South Wales.

METHODS

The survey was undertaken between May 1989 and May 1990, and covered all areas in northern New South Wales in which toads have been predicted to be able to survive (van Beurden 1981; Floyd 1983), and other surrounding areas where climatic conditions are considered unsuitable. A questionnaire was devised (see Figure 1) to obtain information on:

1. toad distribution;
2. date of colonization of particular areas;
3. whether colonization was the result of natural spread or human-introduction;
4. toad abundance (especially in relation to time since colonization), and
5. predation on toads by native species.

The questionnaire, together with a map showing the range of cane toads in 1978, was published during June and July 1989 in all the major newspapers in northern New South Wales. Copies were also sent to all local offices of the New South Wales National Parks and Wildlife Service, Forestry Commission and Department of Agriculture and Fisheries. Additional information was obtained from a "Cane toad phone-in day" held in July 1989, which was advertised through local television and radio stations.

People were asked to respond only if they had seen toads in areas where they had not been recorded in

Figure 1. This cane toad questionnaire was published and circulated in northern New South Wales in June–July 1989.

Cane toad Questionnaire

The distribution of cane toads in New South Wales was last examined over 10 years ago. Are they continuing to expand their range? Please help us find out by filling in this questionnaire, and sending it to: Wendy Seabrook, Sydney University, School Biological Sciences, Sydney, New South Wales 2006.

1. Name .....

2. Current Address .....

.....

3. Name of nearest town .....

4. Tel. .....

5. Distance and direction (i.e., north, south, east or west) of your home from the nearest town .....

.....

6. Have you seen any cane toads in your area? Yes..... No.....

7. If you have, can you please supply the following details for each location:

(a) Name of property or town where you saw cane toads .....

(b) Nearest town .....

(c) Grid Ref (if known) .....

(d) When did you first see toads there?

.....

(e) Do you or a friend know when toads first arrived at that location? .....

(f) Do you or a friend know how toads first got there? .....

(g) How would you describe the numbers of toads?
Rare..... Few..... Many.....

(a) Name of property or town where you saw cane toads .....

(b) Nearest town .....

(c) Grid Ref (if known) .....

(d) When did you first see toads there?

.....

(e) Do you or a friend know when toads first arrived at that location? .....

(f) Do you or a friend know how toads first got there? .....

(g) How would you describe the numbers of toads?
Rare..... Few..... Many.....

8. Have you seen anything eat cane toads (adults, spawn, tadpoles)? Yes..... No.....

9. If you have, can you supply any of the following details?

(a) What animal ate it .....

(b) Did the animal spit it out..... or swallow it.....

(c) Did you manage to watch the animal after it had eaten? Yes..... No.....

(d) If yes, for how long (approx.) .....

(e) Did the animal appear to be ill after eating Yes..... No.....

(f) If the animal appeared ill, please describe in what way .....

.....

(g) Did you see the animal die? Yes..... No.....

(h) If your answer to (g) was no, was this because your were no longer able to watch the animal, or it appeared to get better? Please explain .....

.....

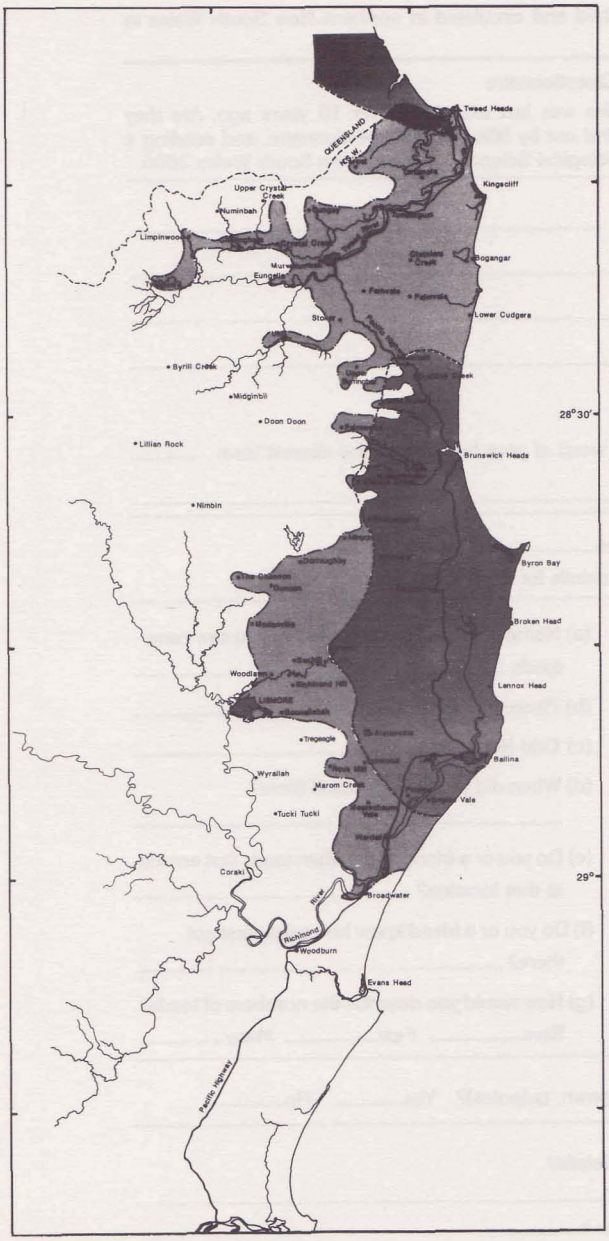

Figure 2. The expansion of the range of cane toads in New South Wales from 1978 to 1990. (– – –) (from van Beurden and Grigg 1980) and 1989 (_._._).

1978, if they had not seen toads in areas where they had been recorded in 1978, and if they could provide any of the other information sought. Information from all sources was verified by interviewing informed local inhabitants (farmers, park managers), local naturalists, and from subsequent visits to the areas concerned during the wet season when toads are more active (van Beurden 1979). The location of each record was mapped, and the information was compiled into a map showing the distribution of cane toads in New South Wales.

RESULTS AND DISCUSSION

The response from the public was good: 36 questionnaires were returned and 161 phone and personal interviews were performed. Most of the reports of cane toads were of individuals seen around dwellings and farms, and on vehicle access routes.

The results show that range expansion of cane toads has continued, and that the population in New South Wales is no longer isolated from the Queensland population (Fig. 2). The population now has a continuous range to Broadwater in the south, and Lismore and The Channon in the south-west. In the higher ground to the west and north-west, cane toads were reported mainly in the valleys. Human observers are concentrated along the valleys, but high ground, or the natural forest vegetation associated with it, appears to have formed a boundary limiting further spread. Toads were reported, for example, to occur right up to the forest edge in the vicinity of the Nightcap Mountain road in 1988, but have not subsequently colonized the higher forested land (D. Kanaley, pers. comm.). No cane toads were reported on the western slopes of the Great Dividing Range.

The range expansion of cane toads in New South Wales is much slower than the 27 km/year recorded in the Northern Territory (Freeland and Martin 1985), and the exponential rate recorded in Queensland before 1980 (Easteal *et al.* 1985). It is assumed that the New South Wales population has spread north since 1978 and the Queensland population south, maximum rate of spread has occurred in a southerly direction at approximately 1.3 km/year. This is slower than the average of 3 km/year recorded between 1965 and 1978 (van Beurden and Grigg 1980), despite apparently better weather conditions for cane toads since 1978. The average annual precipitation and number of days with rain was higher between 1978 and 1989 (1 838 mm and 157.9 days) compared with 1965 to 1978 (1 694 mm and 150.5 days) (Bureau of Meteorology, Cape Byron Lighthouse).

Accidental human-assisted spread was reportedly specifically in the Broadwater, Dunoon, and Yamba areas, and is also likely to have occurred elsewhere. A population has become established in the seaside town of Yamba, 47 km south of Broadwater. In the past, keen gardeners and nurseries frequently imported toads to control insect pests (van Beurden 1980), but most of the

recent reports are of accidental introductions (e.g., in nursery, timber and other consignments). Except for Yamba, where the toads were introduced in a consignment of timber, it is difficult to gauge the importance of humans in assisting the dispersal of toads. Most respondents did not know how cane toads first reached the area where they reported them. Where human-assisted movement was reported, it is not known whether toads were also naturally expanding their range into these areas. However, there are frequent reports of cane toads being transported as far south as Sydney (G. Clancy, M. Dodkin and J. Barker, pers. comm.). Although many of these reports receive considerable media attention (e.g., local newspapers and radio stations), generally only one or two individuals have been involved, and no viable populations have yet become established.

It is not clear what the potential range of cane toads is in New South Wales and Australia in general. On the basis of available models it is larger than that currently occupied. Van Beurden (1981) used the limits of the 1978 distribution and four climatic variables to devise a model to predict future spread. The model included in the potential range: coastal New South Wales and the northern sections of the western slopes of the Great Dividing Range; coastal Victoria and eastern South Australia; the south and north coasts of Western Australia, and the north coast of Tasmania and Northern Territory. Floyd's (1983) predicted range was more conservative and based on the number of weeks that permit or stimulate spawning, combined with those weeks that allow greater than 50% embryonic and larval survival. Using a ten week isoline, the northern sections of the western slopes of the Great Dividing Range are also included, but he predicted that the distribution cane toads could extend south only as far as Wollongong and west to Broome in Western Australia.

Little information was obtained on the impact of cane toads on native wildlife. Three respondents stated that they had seen fewer Red-bellied Black Snakes *Pseudechis porphyriacus,* Blue-tongued Lizards *Tiliqua scincoides,* and Green Tree Frogs *Litoria caerulea,* since the invasion of cane toads into their local area, and two had watched Ibis *Threskiornis* sp., and White-faced Herons *Ardea novaehollandiae,* feeding unharmed on cane toad metamorphs.

Until the impact of the cane toad on native wildlife can be properly evaluated, it is essential that measures are put in place to control further spread of cane toads by humans. This would be difficult to control by legislation, but a public-awareness campaign would help reduce the number being transported both deliberately and inadvertently. The campaign would have to (1) inform the public of the potential for populations to become established outside the current distribution; (2) emphasize and demonstrate how easy it is to inadvertently carry toads; (3) educate the public as to the likely impact of such introductions on wildlife and pets; (4) explain what the public should do in the event of finding a toad, and (5) be especially directed at gardeners and the timber, agricultural and nursery industries.

The population of cane toads in the Yamba area should be eradicated. An eradication campaign has been running in Brisbane for the last few years (R. Nattrass, pers. comm.), and the techniques developed in this programme could be used to design a programme for Yamba. In addition, immediately any cane toads are sighted outside their current distribution, the surrounding areas should be searched, and the local public informed. If necessary, local authorities should be encouraged to organize "cane toad round-up days". Furthermore, as recommended previously by Tyler (1975) and van Beurden (1980), the transportation of live toads for pharmacological research, anatomical studies and other purposes should be prohibited unless live individuals are specifically required, and can be handled under strict management conditions.

ACKNOWLEDGEMENTS

I would like to thank the New South Wales National Parks and Wildlife Service Northern District staff for their logistical support, my supervisor, Dr Chris Dickman, John Barker and Steve Phillips for their advice, and most importantly all the people who responded to the questionnaire and "cane toad phone-in day".

REFERENCES

COVACEVICH, J. AND ARCHER, M., 1975. The distribution of the Cane Toad, *Bufo marinus,* in Australia and its effects on indigenous vertebrates. *Memoirs of the Queensland Museum* **17:** 305–10.

EASTEAL, E., VAN BEURDEN, E. K., FLOYD, R. B. AND SABATH, M. D., 1985. Continuing geographical spread of *Bufo marinus* in Australia: range expansion between 1974 and 1980. *J. Herpetology* **19:** 185–88.

FLOYD, R. B., 1983. Thermal physiology of *Bufo marinus* embryos and larvae: The ecological significance of laboratory observations. Ph.D. Thesis, Griffith University.

FREELAND, W. J., 1985. The need to control cane toads. *Search* **165**(7–8)**:** 211–15.

FREELAND, W. J. AND MARTIN, K. C., 1985. The rate of range expansion by *Bufo marinus* in northern Australia, 1980–84. *Aust. Wildl. Res.* **12:** 555–59.

MUNGOMERY, R. W., 1936. A survey of the feeding habits of the giant toad *(Bufo marinus)* and notes on its progress since introduction to Queensland. *Proc. Qld. Soc. Sugar Cane Technologists* **1936:** 63–74.

TYLER, M. J., 1975. The cane toad *Bufo marinus.* An historical account and modern assessment. The University of Adelaide, Australia.

TYLER, M. J., 1989. Australian Frogs. Viking O'Neil.

VAN BEURDEN, E. K., 1979. Report on the results of stage 2 of an ecological and physiological study of the Queensland cane toad. Unpubl. report to the Australian National Parks and Wildlife Service, Canberra.

VAN BEURDEN, E. K., 1980. Report on the results of stage 3 of an ecological and physiological study of the Queensland cane toad. Unpubl. report to the Australian National Parks and Wildlife Service, Canberra.

VAN BEURDEN, E. K., 1981. Bioclimatic limits to the spread of *Bufo marinus* in Australia: A baseline. *Proc. Ecol. Soc. Aust.* **11:** 143–49.

VAN BEURDEN, E. K. AND GRIGG, G. C., 1980. An isolated and expanding population of the introduced toad *Bufo marinus* in New South Wales. *Aust. Wildl. Res.* **7:** 305–10.

President's Report for 1990–91

Presented at the Annual General Meeting on 14 September, 1991

As foreshadowed in my 1989–90 President's report, a lowering of interest rates for Society investments and increased costs of publication and postage have had potentially serious consequences for the RZS during 1990–91.

However, I am pleased to report that the Society has continued to thrive during the last 12 months and its regular activities have been undertaken with the usual gusto. Society membership has grown, with an unprecedented 50% or more members renewing their membership within a mere three weeks of receipt of renewal notices, and many exciting, long-term projects have come to fruition.

In this report, I would like to direct my attention to three particular areas of Society endeavour during 1990–91: (1) special symposia and publications; (2) grants and awards; and (3) activities and membership.

SYMPOSIA AND PUBLICATIONS

The past 12 months could be fairly called "The Year of the RZS Symposium". During 1990–91 three important symposia were held by the Royal Zoological Society of New South Wales.

"Zoology in Court" was first. The Symposium, convened by Vice-President and Editor, Dan Lunney, was held in November 1990 in the Brasserie at Taronga Zoo (the venue, and admission to the Zoo, being kindly provided by Taronga). The Symposium's aim was to help zoologists come to terms with the legal aspects of presenting their expertise in court. The six invited speakers were barristers or biologists, or both, all with extensive experience at the interface of biology and law, and specifically in how biological evidence is evaluated in court. Following each speaker's presentation was an extensive question time that very effectively enabled all those attending to be involved in the day's proceedings.

The symposium was a very successful venture both in terms of meeting its aims and increasing membership — with 16 new members enrolled on the day and a number subsequently. The entire proceedings (including the open question and answer sessions) will be published by the Society as a special issue of the *Australian Zoologist.*

The second symposium, entitled "The Future of Native Fauna in Western New South Wales", was convened by Councillor David Butcher and held in March, 1991 at the University of New South Wales.

Over a two-day period, 21 invited speakers spoke on a wide range of topics that included the history of land use in western New South Wales, the effects of habitat reduction and fragmentation on our native animals, the present status of native animals in the west, and ways in which problems might be redressed.